

What is claimed is:

1. A bulk acoustic wave device comprising:  
a bulk acoustic wave element including a piezoelectric layer formed on a substrate, a lower electrode contacting a lower surface of the piezoelectric layer, and an upper electrode contacting an upper surface of the piezoelectric layer and partially overlapping the lower electrode, a lower hollow section being formed between the substrate and the lower surface of the piezoelectric layer, a first through-hole reaching the lower hollow section being formed through the bulk acoustic element in a direction perpendicular to a surface of the piezoelectric layer;  
an upper hollow section forming layer forming an upper hollow section with the upper surface of the piezoelectric layer, a second through-hole reaching the upper hollow section being formed therethrough in a direction perpendicular to a surface thereof; and  
a sealing layer covering the upper hollow section forming layer and filling up the second through-hole.
2. The bulk acoustic wave device according to claim 1, wherein the first through-hole and the second through-hole overlap each other.
3. The bulk acoustic wave device according to claim 1, wherein edge portions of the piezoelectric layer are flat, the piezoelectric layer is spaced incrementally apart from the substrate from the edge portions toward a central portion, the central portion is flat, and overlapping portions of the lower electrode and the upper electrode is located at the flat portion of the central portion.
4. The bulk acoustic wave device according to claim 1, wherein at least a surface of the sealing layer is formed of a metal.

5. A bulk acoustic wave device comprising:

a bulk acoustic wave element including a piezoelectric layer formed on a substrate, on which a recess is formed, a lower electrode contacting a lower surface of the piezoelectric layer, and an upper electrode contacting an upper surface of the piezoelectric layer and partially overlapping the lower electrode, a lower hollow section being formed between the recess of the substrate and the lower surface of the piezoelectric layer, a first through-hole reaching the lower hollow section being formed through the bulk acoustic wave element in a direction perpendicular to a surface of the piezoelectric layer;

an upper hollow section forming layer forming an upper hollow section with the upper surface of the piezoelectric layer, a second through-hole reaching the upper hollow section being formed therethrough in a direction perpendicular to a surface thereof; and

a sealing layer covering the upper hollow section forming layer and filling up the second through-hole.

6. The bulk acoustic wave device according to claim 5, wherein the piezoelectric layer is flat.

7. The bulk acoustic wave device according to claim 5, wherein at least a surface of the sealing layer is formed of a metal.

8. A bulk acoustic wave device comprising:

an acoustic reflection layer formed on a substrate;

a bulk acoustic wave element including a piezoelectric layer covering the acoustic reflection layer, a lower electrode contacting a lower surface of the piezoelectric layer, and an upper electrode contacting an upper surface of the piezoelectric layer and partially overlapping the lower electrode;

a hollow section forming layer forming a hollow

section with the upper surface of the piezoelectric layer, a through-hole reach the hollow section being formed in a direction perpendicular to a surface of the hollow section forming layer; and

a sealing layer covering the hollow section forming layer and filling up the through-hole.

9. The bulk acoustic wave device according to claim 8, wherein the piezoelectric layer is flat.

10. The bulk acoustic wave device according to claim 8, wherein the acoustic reflection layer is a Bragg acoustic reflection layer.

11. The bulk acoustic wave device according to claim 8, wherein the acoustic reflection layer is embedded in the substrate.

12. The bulk acoustic wave device according to claim 8, wherein at least a surface of the sealing layer is formed of a metal.

13. A method of manufacturing a bulk acoustic wave device comprising:

forming a first hollow section forming layer on a substrate;

forming a lower electrode so as to cover a part of the first hollow section forming layer;

forming a piezoelectric layer covering the lower electrode and the first hollow section forming layer and having a first through-hole reaching the first hollow section forming layer, the first through-hole extending in a direction perpendicular to a surface of the piezoelectric layer;

forming an upper electrode covering a part of the piezoelectric layer and partially overlapping the lower

electrode;

forming a second hollow section forming layer covering the piezoelectric layer and the upper electrode;

forming an upper hollow section forming layer covering the second hollow section forming layer and having a second through-hole reaching the second hollow section forming layer in a direction perpendicular to a surface of the upper hollow section forming layer;

selectively removing the first and second hollow section forming layers via the first and second through-holes; and

forming a sealing layer covering the upper hollow section forming layer and filling up the second through-hole.

14. A method of manufacturing a bulk acoustic wave device comprising:

forming a recess on a substrate;

forming a first hollow section forming layer embedded in the recess of the substrate;

forming a lower electrode covering at least a part of the first hollow section forming layer;

forming a piezoelectric layer covering the lower electrode and the first hollow section forming layer, and having a first through-hole extending in a direction perpendicular to a surface of the piezoelectric layer and reaching the first hollow section forming layer;

forming an upper electrode covering a part of the piezoelectric layer and partially overlapping the lower electrode;

forming a second hollow section forming layer covering the piezoelectric layer and the upper electrode;

forming an upper hollow section forming layer covering the second hollow section forming layer, and having a second through-hole extending in a direction perpendicular to a surface of the upper hollow section forming layer and reaching the second hollow section forming layer;

selectively removing the first and second hollow section forming layers via the first and second through-holes; and

forming a sealing layer covering the upper hollow section forming layer and filling up the second through-hole.

15. A method of manufacturing a bulk acoustic wave device comprising:

forming a recess on a substrate;

forming an acoustic reflection layer embedded in the recess of the substrate;

forming a lower electrode covering at least a part of the acoustic reflection layer;

forming a piezoelectric layer covering the lower electrode and the acoustic reflection layer;

forming an upper electrode covering a part of the piezoelectric layer and partially overlapping the lower electrode;

forming a hollow section forming layer covering the piezoelectric layer and the upper electrode;

forming a hollow section forming layer covering the hollow section forming layer, and having a through-hole extending in a direction perpendicular to a surface of the hollow section forming layer and reaching the hollow section forming layer;

selectively removing the hollow section forming layer via the through-hole; and

forming a sealing layer covering the hollow section forming layer and filling up the through-hole.